LASER FUSION
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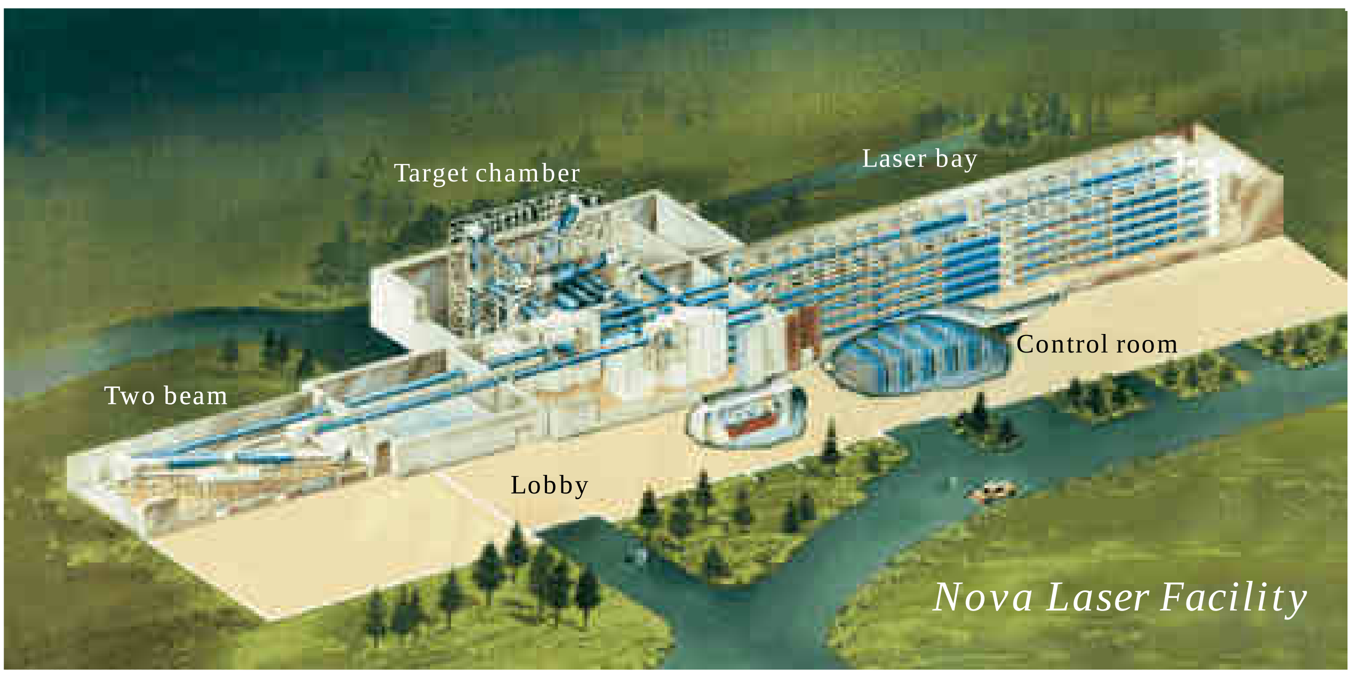
Laser Fusion Virtual Tours

http://ep.llnl.gov/nova/welcome.html

The “Virtual Reality” tours of laser fusion facilities described here are part of a joint effort by the Inertial Confinement Fusion and Education Programs at Lawrence Livermore National Laboratory (LLNL) in support of a broad education and public outreach program, NIFTY. NIFTY (NIF for Teachers and Youth) will provide related curricula for K–Grad students and teachers, as well as opportunities to participate in research on the Nova Laser Facility and ultimately on the National Ignition Facility. This brochure, the virtual tours, and additional education material are available at http://lasers.llnl.gov/lasers/education/ed.html

Nova Virtual Tour

http://ep.llnl.gov/nova/nova.html



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The cutaway view above shows the layout of the Nova Laser Facility. A virtual reality tour of Nova allows you to tour various areas by “clicking” on the building areas that are highlighted. Within the laser bay, a 225-foot-long space frame supports the ten laser amplifier chains that transport and amplify the individual laser beams. A system of mirrors and lens causes the ten, 2.5-foot-diameter laser beams to simultaneously illuminate the fusion fuel target (see pg. 4), which is centered in a 16-foot-diameter spherical target chamber.

The Nova laser can deliver very high power to its targets (about 15 trillion watts of ultraviolet light for three billionths of a second). The laser light pulse can be “shaped” in time and intensity and “tuned” to different wavelengths by an array of crystals in each beamline at the target chamber. Most common wavelengths are either invisible infrared light or shorter-wavelength visible green or ultraviolet blue light. Nova’s world-class diagnostic capabilities make Nova an invaluable tool for gathering data about laser fusion.

BEAMLET VIRTUAL TOUR

http://ep.llnl.gov/nova/beamlet.html

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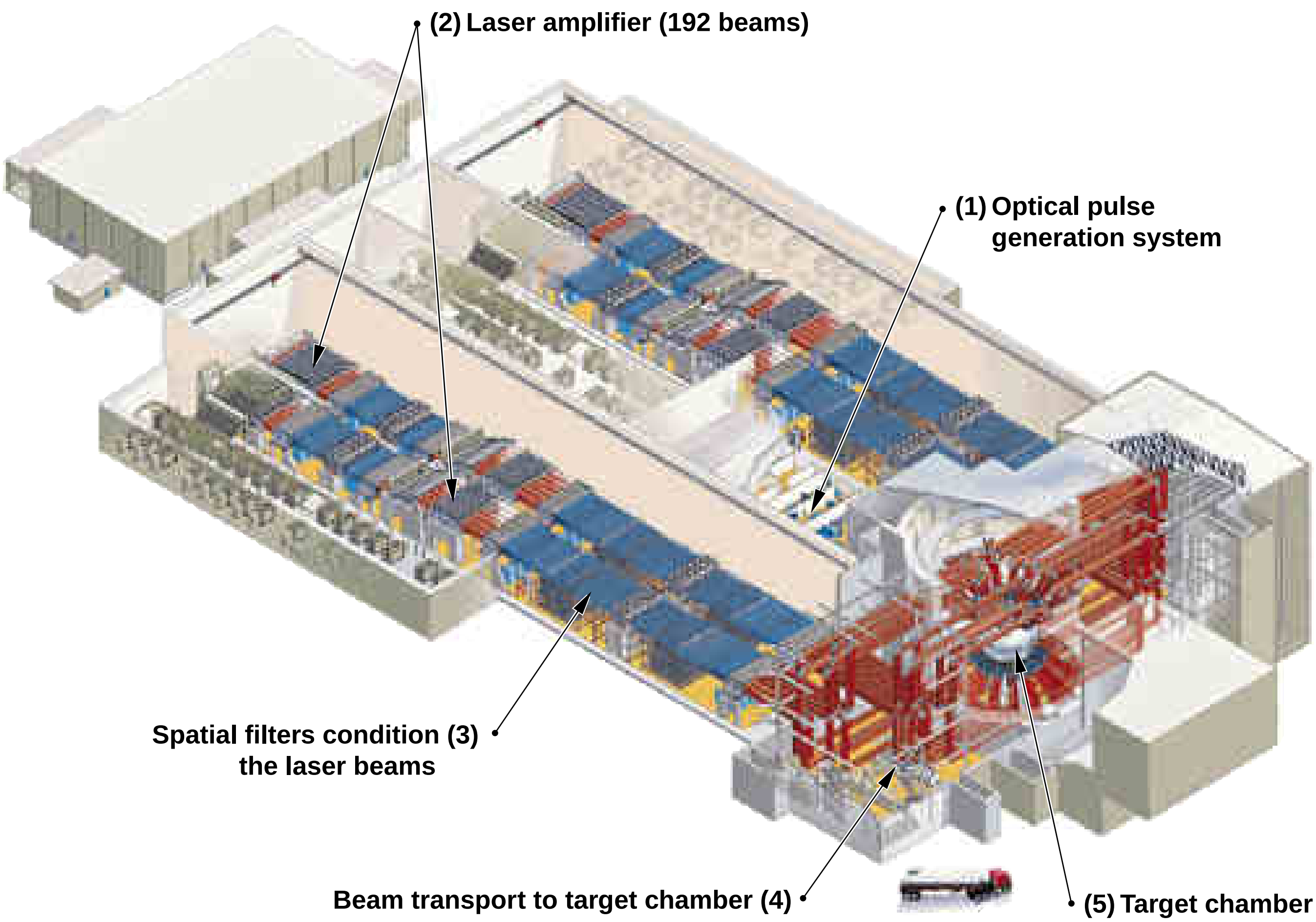
The Beamlet is a scientific prototype for one of the 192 beamlines of the National Ignition Facility laser (see pg. 3). It operates in a regime of laser energy density never before achieved by Inertial Confinement Fusion lasers. The Beamlet serves as a full-scale testbed for NIF optics and incorporates technology developments and material advances. Its design allows the laser beam to pass several times through each optical amplifier, making it 20 times more compact than the Nova laser's single pass design. The Beamlet's final laser spot size is focused to less than twice the diffraction limit, which attests to the excellent laser beam quality achieved by using a state-of-the-art adaptive optics system. This adaptive optics system represents just one of the many novel technologies successfully demonstrated on Beamlet that have never been used on other ICF lasers.

NIF VIRTUAL TOUR

http://www-lasers.llnl.gov/lasers/nif.html



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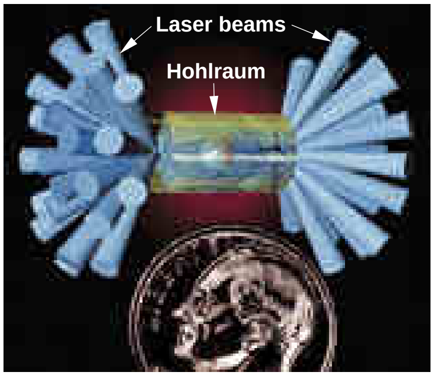
The Sun and the stars are natural fusion "power plants" that produce more energy than they consume, a phenomenon called energy gain. Scientists anticipate using the National Ignition Facility (NIF) to achieve the long-sought goal of producing—for the first time in a laboratory—net energy gain from fusion ignition (see pg. 4). The heart of the NIF is a powerful laser whose energy will "ignite" small targets (see pg. 4) filled with fusion fuel. The NIF will generate beams of laser light (1) that are amplified successively to greatly increase their energy (2), conditioned to obtain the desired optical characteristics (3), and transported through large beam tubes (4) to a 34-foot-diameter spherical target chamber (5), where the laser energy will begin the fusion process. NIF will produce 40 times more energy and 10 times more power than Nova.

INERTIAL CONFINEMENT FUSION (ICF)

http://lasers.llnl.gov/lasers/nif/nif_ife.html



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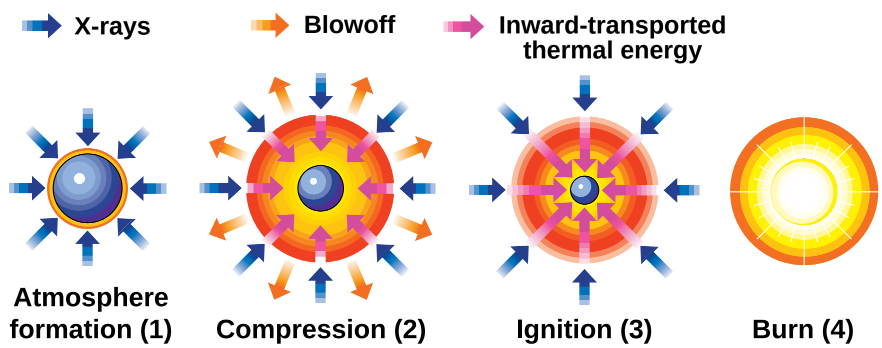

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In inertial confinement fusion experiments, laser beams enter holes and strike the inside wall of a hohlraum, a small cylinder that holds a pea-size fusion fuel capsule. Laser energy heats the inside of the hohlraum, creating x rays that surround the spherical capsule (or target). The x rays rapidly heat the capsule inside the hohlraum (1), causing the capsule's surface to fly outward (2). This outward force causes an opposing inward force that compresses the fusion fuel (hydrogen isotopes) inside the capsule. When the compression reaches the center, temperatures increase to 100,000,000°C, igniting (self-sustaining) the fusion fuel (3) and producing a laser fusion thermonuclear burn that generates a fusion energy output many times the laser energy input (a phenomenon called energy gain) (4).

MORE INERTIAL FUSION INFORMATION

http://lasers.llnl.gov/lasers/education/ed.html

One of the more important aspects of ICF research is the national nature of the program. LLNL's ICF program falls within DOE's national ICF program (http://www3.dp.doe.gov/IFNIF/ICF.HTM), which includes the Nova and Beamlet laser facilities at LLNL, as well as the OMEGA (University of Rochester [Laboratory for Laser Energetics, UR/LLE]), Nike (Naval Research Laboratory [NRL]), and the Trident (Los Alamos National Laboratory [LANL]) laser facilities. The Particle Beam Fusion Accelerator (PBFA) and the Saturn pulsed-power facilities are at Sandia National Laboratory (SNL). General Atomics, Inc. (GA), develops and provides many of the targets for the above experimental facilities. Each of these ICF research institutions maintains its own WWW pages, which are listed on LLNL's Laser Programs Education home page at http://lasers.llnl.gov/lasers/education/ed.html.

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